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# Stuttgarter Beiträge zur Naturkunde

## Serie A (Biologie)

Herausgeber:

Staatliches Museum für Naturkunde, Rosenstein 1, D-70191 Stuttgart

Stuttgarter Beitr. Naturk.	Ser. A	Nr. 557	7 S.	Stuttgart, 1. 10. 1997
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### First Record of Rhizocephala (Crustacea: Cirripedia) from Turkish Waters, with Notes on Lessepsian Migration

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With 2 figures

#### Summary

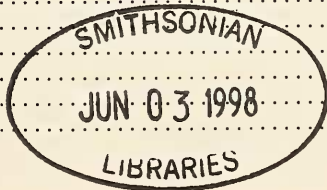
Three species of parasitic sacculinid rhizocephalans (Crustacea: Cirripedia), *Heterosaccus dollfusi* Boschma 1960 on the host *Charybdis longicollis* Leene 1938; *Sacculina gonoplaxae* Guérin-Ganivet 1911 on the host *Goneplax rhomboides* (L. 1758) and *Sacculina zariquieyi* Boschma 1947 on the host *Xantho* sp. are recorded for the first time from the Turkish Mediterranean coast. This is the first record of any rhizocephalans from Turkish waters. Aspects of the dispersal of the lessepsian migrant *Heterosaccus dollfusi* are discussed.

#### Zusammenfassung

Drei Arten parasitischer Rhizocephalen (Crustacea: Cirripedia): *Heterosaccus dollfusi* Boschma 1960 (Wirt: *Charybdis longicollis* Leene 1938); *Sacculina gonoplaxae* Guérin-Ganivet 1911 [Wirt: *Goneplax rhomboides* (L. 1758)] und *Sacculina zariquieyi* Boschma 1947 (Wirt: *Xantho* sp.) werden erstmals in türkischen Gewässern nachgewiesen. Es ist der erste Nachweis über Rhizocephalen in der Türkei. Die Art und Weise der Ausbreitung des Lesseps'schen Migranten *Heterosaccus dollfusi* wird erörtert.

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## 1. Introduction

Since 1985 a study of the brachyuran crabs off the Turkish Mediterranean and Aegean coasts has been initiated with special emphasis to detecting newcomers, specially Lessepsian migrants from the Red Sea (ENZENROU *et alii*, 1992; ENZENROSS & ENZENROSS, 1995). The collected materials include three species of crabs parasitized by sacculinid rhizocephalans, all of which are previously unrecorded from the area. The parasites are identified as *Heterosaccus dollfusi* on the host *Charybdis longicollis*, *Sacculina gonoplaxae* on the host *Goneplax rhomboides*, and *Sacculina zariquieyi* on the host *Xantho* sp.

## 2. Materials and methods

All crabs except one were taken in standing nets and were preserved in 70% alcohol. Only complete specimens were sampled. No crabs were dissected; the data refer to visibly infected crabs only. Only a minor part of the crabs observed were collected for closer examination. Notes were taken on morphological modifications in the host caused by parasites. Sexes and sizes of the specimens were determined. Measurements are taken to the nearest millimeter [mm]. Host carapace widths (CB) were measured as the maximum distance between the tips of the lateral spines.

Parasite sizes are measured as maximum body height. One specimen of *S. gonoplaxae* and *S. zariquieyi* each was embedded in paraffine serially cut into sections of 10 µm, and stained using hematoxyline and eosin. Pieces of the mantle of these species were embedded in Araldite and cut into 2 µm wide sections, and stained with toluidine blue. All parasites were checked for progeny in the mantle cavity.

The material is deposited in the Staatliches Museum für Naturkunde Stuttgart (SMNS) and in the ENZENROSS Mediterranean Collection, Ravensburg (ER).

## 3. The species

### 3.1. *Heterosaccus dollfusi* Boschma 1960

Host: *Charybdis longicollis* Leene. Family Portunidae.

Material: 2 sps (8 and 18 mm) on ♂ crab (CB 29 mm) and 2 sps (15 and 22 mm) on ♂ (CB 42 mm); SMNS Zia 9306; Turkey, western Fener Burnu; 23 m; 23 Apr. 1994. – 2 sps (13 and 17 mm) on ♂ crab (CB 32); 1 sp (17 mm) on ♂ crab (CB 35 mm) and 2 sps (11 and 18 mm) on ♀ crab (CB 36 mm); ER 11.503.A; Turkey, SW of Karatas, between harbour and Fener Burnu; 16 m; 3 Apr. 1995. – 1 sp (20 mm) on ♀ (CB 37 mm); ER 11.492.A; Turkey, between Akyatan-Mündung (Dalyan-Bogazi) and Tuzla; 12 m; 17 Apr. 1995. – 1 sp 18 mm on ♂ crab (CB 34 mm); 1 sp (18 mm) on ♀ crab (CB 37 mm) and 1 sp (22 mm) on ♀ crab (CB 39 mm); ER 11.494.A; Turkey, off Karatas, SE of harbor; 10 m; 25 Apr 1995. – 2 sps (11 and 27 mm) on one abdomen and 1 sp (19 mm) on one abdomen; ER 9.590.A; Turkey, off Karatas, Apr. 1995.

Remarks: *Heterosaccus dollfusi* is a Lessepsian migrant, which entered the Mediterranean from the Red Sea, transported by its host *Charybdis longicollis* (GALIL & LÜTZEN, 1995). The first record of the crab from the Mediterranean was from the Bay of Mersin, Turkey, 1954 (HOLTHUIS, 1961). Since that date, it has been recorded from the Levant coasts of Egypt, Israel, Lebanon and Cyprus (LEWINSOHN & HOLTHUIS, 1986). In that area, the parasite was previously known only to occur along the Mediterranean coast of Israel (GALIL & LÜTZEN, 1995). Outside the Mediterranean, *H. dollfusi* is only known from the Gulf of Suez (MONOD, 1938; BOSCHMA, 1960 a).

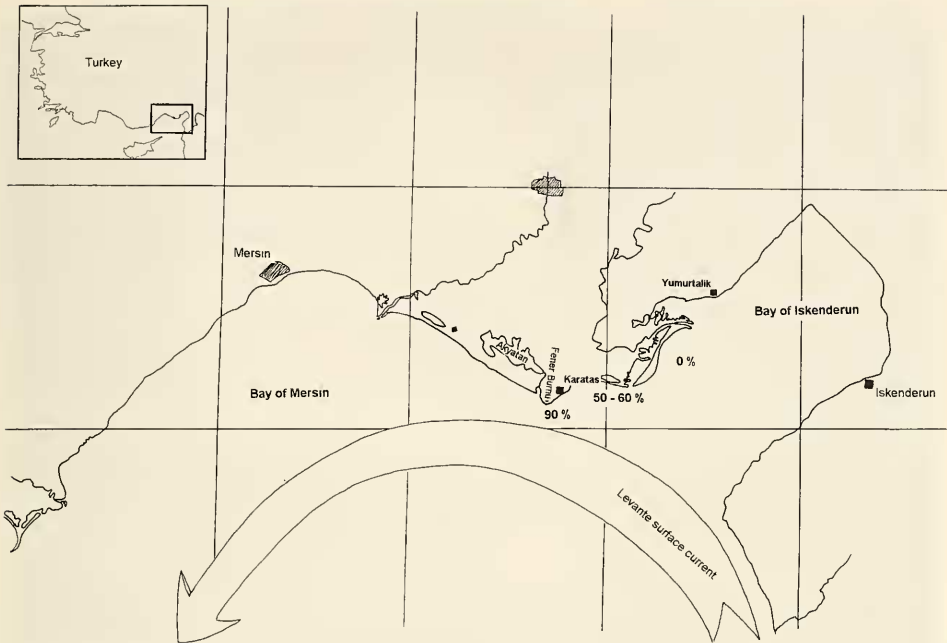


Fig. 1. Distribution of *Heterosaccus dollfusi* along the coast of Bay of Mersin and Bay of Iskenderun, southern Turkey (see inset) in 1995. Figures indicate proportions of infected specimens.

Two of us (RE and LE) have frequently collected *C. longicollis* from the Turkish Mediterranean coast since 1985, and found a steady rise in the population sizes during this period. Until the spring of 1994, none of the specimens were parasitized by rhizocephalans. The above-mentioned specimens, collected in Apr. 1994, are the first *H. dollfusi* recorded from the Mediterranean coast of Turkey.

The proportions of infected crabs vary over the known geographical range. During the spring of 1995, 35 of 39 (approximately 90%) of the crabs caught between Fener Burnu and Karatas were visibly infected (Fig. 1). To the east of Karatas the proportion was estimated at 50–60%, with proportions declining towards the east into the Bay of Iskenderun. Midway between Karatas and Yumurtalik, and further east, no infected specimens have been recorded at all (Fig. 1). GALIL & LÜTZEN (1995) found 55% of the males and 43% of the females visibly infected during May trawl collections of Palmahim, Israel.

Major differences in proportions of sacculinid infection between neighboring geographical areas have been observed at several occasions (overview by YAMAGUCHI et alii, 1994). Information on the dispersal of nauplii and infected crabs over larger ranges is scarce.

The apparent absence of infected crabs in the inner parts of the Bay of Iskenderun, and the lower proportion east of Karatas, compared to the area west of Karatas, could be explained by several scenarios. If the dispersal of parasite nauplii is strictly local, the parasites can only spread over large distances transported by their host. If so, crabs infected with *H. dollfusi* migrating northward from Israel should also be present within the inner parts of the Bay of Iskenderun. Otherwise, the migration

towards the north and west of the bay might have been caused by nauplii or infected crabs crossing the bay's mouth.

Dispersal of parasite nauplii over long distances by way of the prevailing currents is another possible scenario. As the Levante Surface Current is heading northward, turning westward along the coast of Karatas, nauplii might be transported with the current, thus reaching the areas west of Karatas first. The presence of parasitized crabs east of Karatas must subsequently have been generated by local step-by-step dispersal by the parasitized crabs. If so, prevalences should gradually rise in the area east of Karatas, and parasitized crabs should be observed further east into the bay within the next few years.

The colour of *H. dollfusi* changes according to age and development. Immature parasites appear whitish, but with maturity turns yellow, then yellowish-brown. Older parasites are known to become dark brown with a thick and wrinkled cuticle (GALIL & LÜTZEN, 1995).

Of the 11 hosts examined, 6 only had a single parasite, while 5 had two parasites. No multiple infections with a higher number of parasites were recorded, though up to five parasites per host are reported to occur along the Israelite coast (GALIL & LÜTZEN, 1995). Half of the parasites examined were ovigerous. No hyperparasites were found on this species.

Compared to uninfected specimens all parasitized hosts showed a high degree of modifications as an effect of parasitism. The males had lost their copulatory appendages, and acquired unusually broad abdomina, gaining mobility in the segments normally fused. The parasitized females had lost all swimmerets.

### 3.2. *Sacculina gonoplaxae* Guérin-Ganivet 1911 (Fig. 2)

Host: *Goneplax rhomboides* (L.) [as a rhizocephalan host often referred to as *Goneplax angulata* (Pennant)]. Family Goneplacidae.

Material: 2 sp (5 and 8 mm) on ♀ crab (CB 27 mm); SMNS ZIa 9337; Turkey; western Fener Burnu; 15 m; 9 Apr. 1994.

Remarks: There are only few earlier records of *Sacculina gonoplaxae* from the Mediterranean. The parasite has previously been recorded on *Goneplax rhomboides* [probably northern Tyrrhenian Sea and Gulf of Marseille (RICHIARDI, 1875; MARION, 1883)], and from the Gulf of Naples (SMITH, 1906; BOSCHMA 1927 a, 1927 b, 1933). Furthermore the species has been recorded parasitizing *Pilumnus spinifer* H. Milne Edwards off Rovinj and off the Island Sv. Ivan, near Rovinj, Croatia (BOSCHMA, 1961). This is the first record of *S. gonoplaxae* from the Turkish coast, and from the eastern Mediterranean.

Outside the Mediterranean, *S. gonoplaxae* has been recorded parasitizing *G. rhomboides* from the type locality, gulf of Cadiz (GUÉRIN-GANIVET, 1911), from the Atlantic coast of Morocco (BOSCHMA, 1933), Isle of Man and Firth of Clyde (BOSCHMA 1958, NAGABHUSHANAM, 1958). According to BOSCHMA (1958), *S. gonoplaxae* differs from *S. dayi* Boschma 1958, parasitizing *G. rhomboides* off the coast of South Africa, only in minor anatomical details. It is worth to note that a specimen of *S. dayi* has been recorded off the coast of Israel, near Netanya (BOSCHMA, 1960 b).



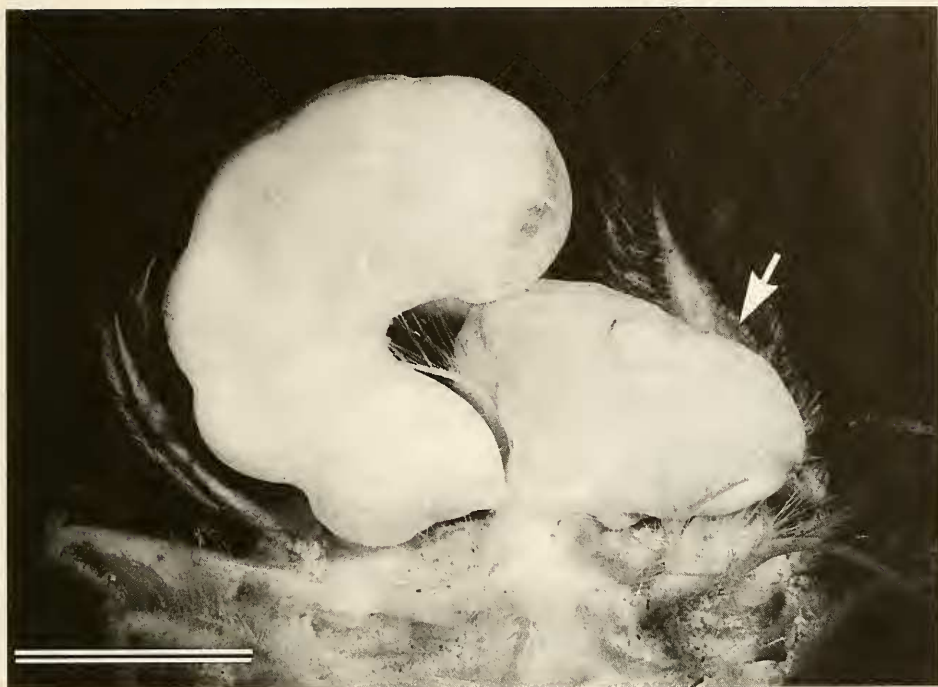


Fig. 2. *Sacculina gonoplaxae* (SMNS ZIa 9337) with a hyperparasitic isopod, on the abdomen of the crab *Goneplax rhomboides*. The other two *S. gonoplaxae* have been removed. – The arrow indicates the rhizocephalan. – Scale bar: 50  $\mu$ m.

The smaller of the two parasites is an immature with a bright yellowish colour. The larger has a considerably damaged exterior with a slightly darker yellow colour, flashed by brownish textures from the sides of the larger wrinkles. This specimen is hyperparasitized by a large cryptoniscan isopod, possibly a *Danalia* sp., based on the stalk of the rhizocephalan host (Fig. 2). None of the rhizocephalans were ovigerous.

The host showed no apparent modification connected to the presence of the parasites.

### 3.3. *Sacculina zariquieyi* Boschma 1947

Host: *Xantho* sp. Family Xanthidae.

Material: 2 sps (5 and 5 mm) (sex of the lost host crab not identified); SMNS ZIa 3789; Turkey, Subucak, Aegean Sea; intertidal collection; 21 May 1989.

Remarks: This species has previously only been recorded from the Catalanian coast, Spain (BOSCHMA, 1947), and from Torremolinos, Málaga, Spain (ØKSNEBJERG, in prep.), both on the host *Monodaeus couchi* (Couch 1851) (= *Xantho couchi*). This is the first record of *S. zariquieyi* from the eastern Mediterranean.

*S. zariquieyi* shows some resemblance to *S. gonoplaxae* Guérin-Ganivet (BOSCHMA, 1947), *S. gonoplaxae*, however, is only known to parasitize *Goneplax rhom-*

*boides* and *Pilumnus spinifer*, but has never been recorded on *Xantho* sp. Both previously recorded specimens of *S. zariquieyi* have been from *Monodaeus* (= *Xantho*) *couchi*.

The identification of the above-mentioned specimens is based on the structure of the excrescences of the external cuticle (BOSCHMA, 1947). Sections of the external cuticle of the species were compared with *S. zariquieyi* from Torremolinos, Malaga, and *S. gonoplaxae* (present material). The two specimens of *S. zariquieyi* both have regularly dispersed, long and slender papillae with minute lateral hairs, whereas the excrescences of the cuticle of *S. gonoplaxae* were irregularly dispersed, with a stout, pyramid-like shape.

The two specimens were light yellow. Both externas were ovigerous. No hyperparasites were found on the parasites.

#### 4. Acknowledgements

We thank Drs. JØRGEN LÜTZEN and JENS T. HØEG (Zoological Institute, University of Copenhagen) for valuable discussions. Dr. J. ENRIQUE GARCÍA RASO (Dept. Biología Animal, Universidad de Málaga) kindly provided us with a specimen of *S. zariquieyi*. We are grateful to TINA OLESEN (Zoological Institute, Copenhagen), for technical assistance. H.-J. NIEDERHÖFER and Dr. R. FRICKE (Stuttgart) assisted in improving the English.

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